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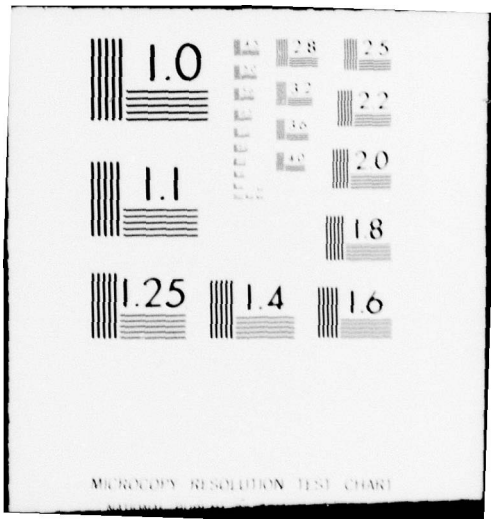
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FOREIGN TECHNOLOGY DIVISION

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by

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THE FEASIBILITY OF USING A CONVERSATIONAL LANGUAGE IN COMPLEX AUTOMATION SYSTEMS OPERATING IN THE ADVISORY MODE

by

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This articles discusses the startup of an Operational Production Planning [OPP] program, written in JEAN conversational language at the Janikow Soda Plants.

1. Methods of Computer Operation in Industrial Automation Systems

With respect to the method of connecting a computer to a ~~unit~~ system, the following types of computer operation in industrial automation systems are distinguished: operation in the off-line mode, operation in the off-line mode [Translator's Note: sic; presumably "on-line" was intended here].

In systems operating in the off-line mode the computer is not connected to an operating installation of the ~~unit~~ system. The input data needed for calculation [analysis] are prepared manually and supplied to the computer using the appropriate information carriers, e.g., perforated cards or tapes. The computer performs its analysis according to the appropriate programs stored in its memory at the request of the user. Technical and economic calculations [analyses] are

usually involved which enable a user to evaluate the production process. The results are retrieved on the perforating equipment available, e.g., on a line printer.

In systems operating in the on-line mode the input data are supplied automatically from sensors installed in the ~~unit~~ system. These systems can be used for recording, data processing and control. In the case of recording and data processing, an appropriate computer program takes care of servicing the measuring points, controling the values of the process parameters, printing out operational reports and technical reports, either automatically or at the request of the operator.

Use of a computer for control in the on-line mode is the most advanced computer application in industrial automation. Two basic methods of accomplishing this control can be distinguished: primary control and direct digital control (English DDC).

In the first case, the computer automatically corrects the assigned values on the conventional automation regulators. The second method of control consists of the fact that the computer replaces the action of the regulators, automatically sending signals to the conventional automation elements that perform a certain function.

Individual systems for computer operation in industrial automation systems are shown in Fig. 1.

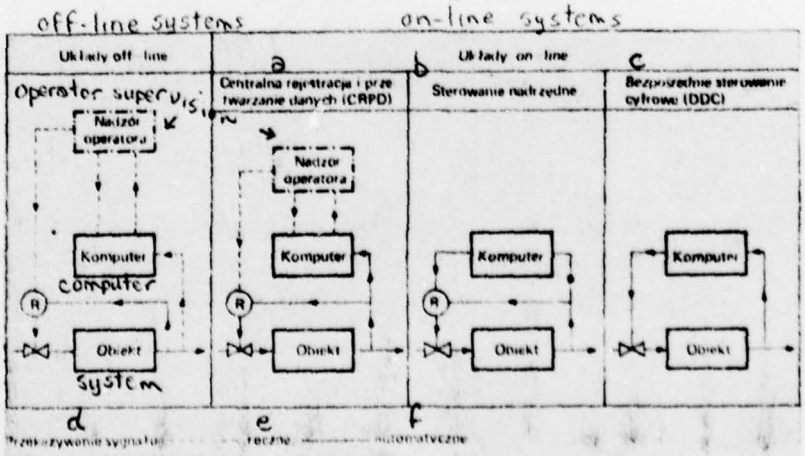

Fig 1.

Legend: a) Central recording and data processing; b) primary control; c) direct digital control; d) transmission of signal; e) manual; f) automatic

A characteristic feature of a computer operating in an industrial automation system is the so-called real-time operation (English real-time). This means that the accomplishment of individual programs occurs within frames of time derived from the time required for the process.

Control in the advisory mode can play a significant role in the case of simple computerized automation systems. It is characterized by the fact that, in the off-line mode and at times in the on-line mode (automatic introduction of input data), programs are operating that supply results which form the basis of an operator's decision concerning the method for controling the process. Both the time intervals within which the programs are performed as well as the operator's decisions are dictated by the process requirements, and that is why we can say that control in the advisory mode takes place in real time.

One of the most important aspects in using computers for industrial automation is the problem of communication between the process operator and the computer (the process operator still plays the all-important decision making role in computer systems). The solution to this problem is related to the use of appropriate technical measures that permit communication with the computer and the appropriate progamming. The use of conversational languages (e.g., BASIC, JEAN, TELSIM) that permit the operator to communicate with the computer can prove to be particularly useful in this regard.

2. Conversational Languages and Their Use

With the aid of a conversational language, an operator can make direct contact with a computer via a terminal (e.g., a teletype), which means that he has the capability of conducting a direct dialogue with the computer, or else can carry out calculations based on previously prepared programs.

After entering the problem under consideration onto the teletype in the conversational language chosen, the operator can obtain the solution to this problem right away on the teletype. This enables

him to test various methods for solving problems and to choose the optimum concepts.

Theoretically, every problem expressed mathematically can be solved using a computer operating in the conversational mode. Despite the fact that conversational languages are not an appropriate tool for creating lengthly programs, with their help it is possible nonetheless to test with great ease and speed the analytical algorithms which make up complicated programs written in the ALGOL or FORTRAN languages.

A great possibility exists for using conversational mode operation in the majority of engineering calculations (e.g., in strength calculations), statistical calculations and other mathematical calculations in industrial engineering (analysis and conversion of many industrial process parameters). The possibilities of direct cooperation between man and the computer has also permitted methods of simulation [modeling] to be worked out in the conversational mode of operation. Conversational simulation languages (e.g., OPS-3, OPS-4, TELSIM) permit construction of the model during simulation and enable the user to play a direct role in the simulation process [1].

Conversational languages can be used is single- and multiple-access systems. Operation in a multiple-access system (the connection of several teletypes ~~with~~ to a computer using a multiplexer) makes effective use of computer time possible and permits the simultaneous operation of many users. A conversational language can be an excellent tool for operation in the advisory mode in complex computerized automation systems. For example, periodically collected data related to a controlled industrial process can be introduced via a teletype into the computers memory, into which a program describing the the method for production control had been introduced previously (written in a given conversational language). The results of the analysis, printed on the teletype, enable the dispatcher to make the appropriate decision.

The use of conversational languages for this purpose involves a

significant reduction in the costs associated with equipment and special programming. This is of particular importance in planning and introducing simple computerized automation systems.

3. Description of a Test on the Use of the JEAN Conversational Language for Control in the Advisory Mode

One of the conversational languages is the JEAN language devised by the ICL [2]. This language (described in [6]) in particular can be used with the Odra 1305 and 1325 computers.

Two operational modes in JEAN language are possible: the immediate calculations mode and the programmed calculations mode. In the immediate calculations mode each instruction is performed immediately after it is entered on the teletype. In the programmed calculations mode, consecutive instructions are remembered by the computer and their performance occurs only upon the special request of the user.

The feasibility of using the JEAN conversational language for operation in the advisory mode was verified at the Janikow Soda Plants in the central control and data processing system introduced there using a computer which employed an Operational Production Planning (OPP) program written and verified earlier in FORTRAN language [3].

The OPP program serves for production planning at an assigned level of planning using a computerized data processing and control system, together with a network of special instruments for remote, manual introduction of data in the form of NIC digital information transmitters (belonging to the INTELDIGIT subsystem of the POLMATIK system).

An alternative test was performed on starting up an OPP program translated into the JEAN conversational language. The main purpose of the test was to achieve the same (or very similar) action and service of the OPP program as in the designed version, but without the special equipment. The test was performed with the following set-up: an Odra 1325 central unit, 7070/2 uniplexer and a 7071 teletype.

The following are the advantages of using a conversational language for this purpose.

- enables the process operator to start up the program from the teletype at any moment,
- permits the introduction of data from the teletype at any moment,
- eliminates the need to use special programming (SZPAK), or programming from drum memories, equipment connected to the ~~unit~~ system and digital information transmitters (NIC).

A drawback in using a conversational language is the fact that data cannot be collected directly from the ~~unit~~ system.

The development and start-up of the OPP program took place in several stages. At the beginning, the OPP program was translated from FORTRAN language in to JEAN language. Owing to the length of the OPP program, the translation was laborious but did not create any real difficulties since there is a great similarity between the basic FORTRAN and JEAN instructions.

Next, using a Consul machine the program devised was punched out onto a paper tape and introduced into the computer's memory from the teletype's tape reader. In order to avoid a lengthly introduction process of consecutive instructions as single messages, the entire program was treated as ~~one~~ a single message of many instructions which requires only a single acceptance by the conversational system. The length of time for this operation, nevertheless, amounted to about 1/2 hour.

The next step was to test the action of the program. The program comprised two parts (a data introduction part and an execution part) which were started separately.

After starting the first part and introducing data into the operational memory, considerable trouble was encountered in carrying out the second part, during which time the conversational system did not produce any standardized message concerning the state of operation.

From the tests conducted it follows that the OPP program (in JEAN language) in its present structure cannot be fully achieved by the JEAN conversational system. After conducting brief verification tests on the possibilities of the system, the probable reason ~~fro~~ for this situation was determined.

It must be recognized that implementation of the JEAN language for the Odra 1325 computer possesses a limit in the number of repititions in the same portion of the program in which communication instructions with the teletype do not occur. When this limit is passed a breakdown in communication occurs during which no standardized message is printed. On the other hand, the number of repititions of a portion of the program in which communication via the teletype between the user and system occurs (print-outs, page changes, request ~~fro~~ for data, etc.) is unrestricted.

Undoubtedly, the limitation described is related to the internal control of the conversational system which guards against possible calculation difficulties in the programs (usually difficult to identify) and is most desirable in a system of multiple-access operation, i.e., when the same machine is being operated by many users.

Thus, the OPP program could be accomplished in JEAN language only if it is given a structure other than the one it had in FORTRAN language.

4. Conclusions Related to the Use of Conversational Languages in Industrial Automation Systems on the Example of the JEAN Language

The performance of the test discussed under 3, part to write and set in operation an extensive calculation program in the JEAN conversational language led to the following conclusions:

- The JEAN conversational language is a very simple language and easy to master.
- This language turns out to be excellent for calculating a not too very large number of complicated mathematical and engineering problems.

- Setting up large and complicated calculation programs in this language is hampered by the large amount of work associated with introduction of the program into the computer's memory and the need to use artificial support for communication between the system and the user (inserting instructions into the program which causes,e.g., print-outs on the teletype during calculation of the program) in fragments that contain long iterative calculations.
- The JEAN conversational language can serve as a tool in the advisory operation mode, but the calculated program cannot be too long and cannot contain long iterative calculations; for long and complicated programs it is more convenient to use, e.g., the FORTRAN language.
- In complex automation systems in which for other reasons (operation in the on-line mode) an auxiliary memory, equipment for connection to the unit, and NIC transmitters must be installed apart from the computer, it is more convenient to use programs written in FORTRAN language, operating under the control of a SZPAK system.

In conclusion it should be pointed out that BASIC is becoming ever more widespread as a conversational language at present. For this reason any user who has the freedom to choose between JEAN and BASIC ought to decide on BASIC.

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